

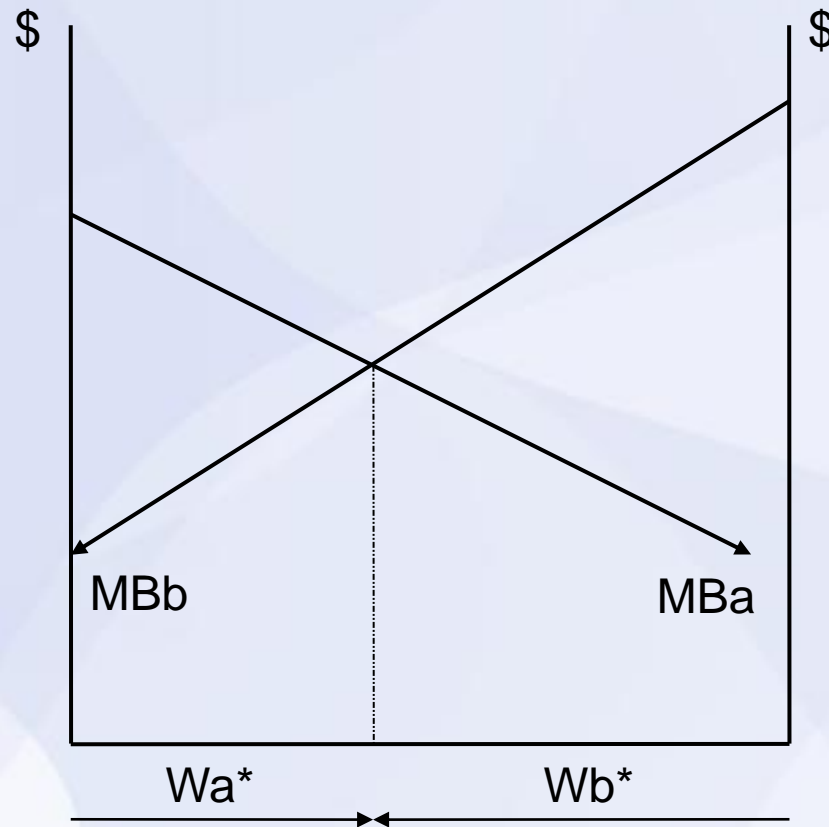
Corner solutions in the allocation of environmental water: an application of inframarginal economics

Simon Hone

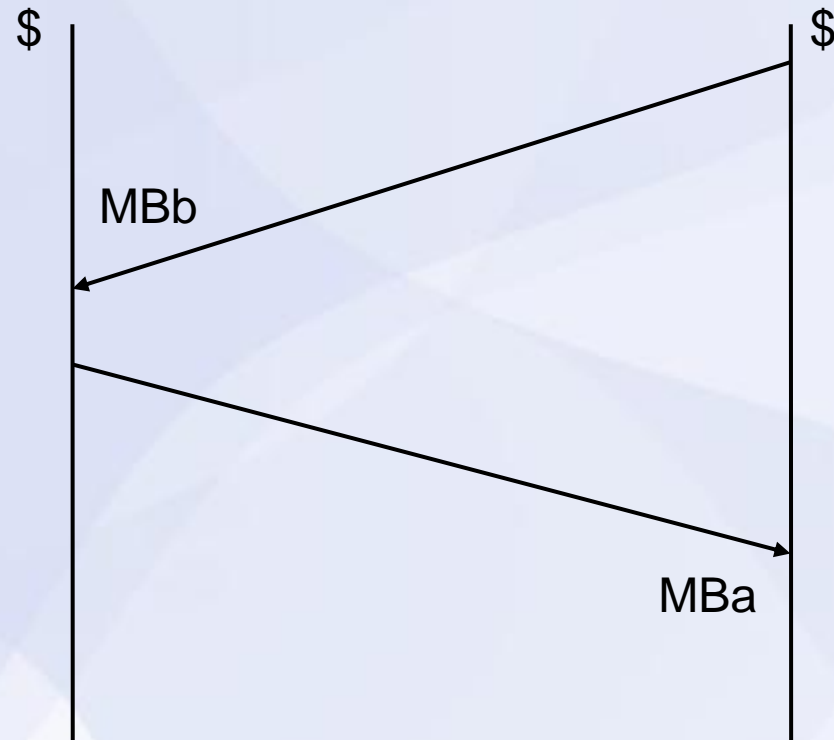
Allocating environmental water

- Health of many river systems declining
- Governments acquiring billions of dollars of environmental water
- Massive central planning problem
- Institutional arrangements

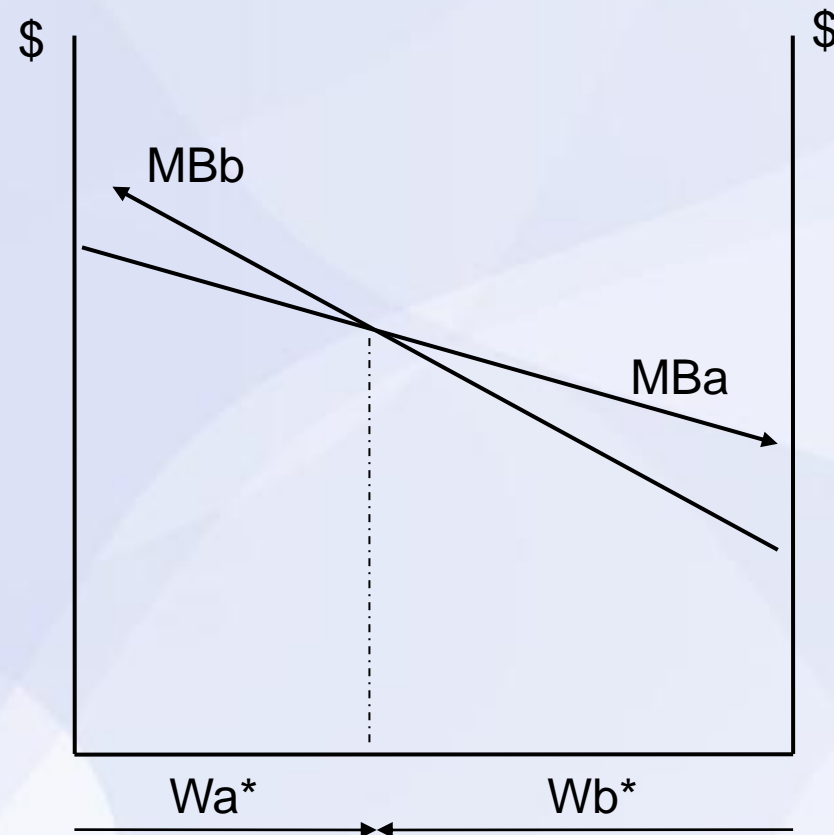
The 'marginal framework'



No intersection

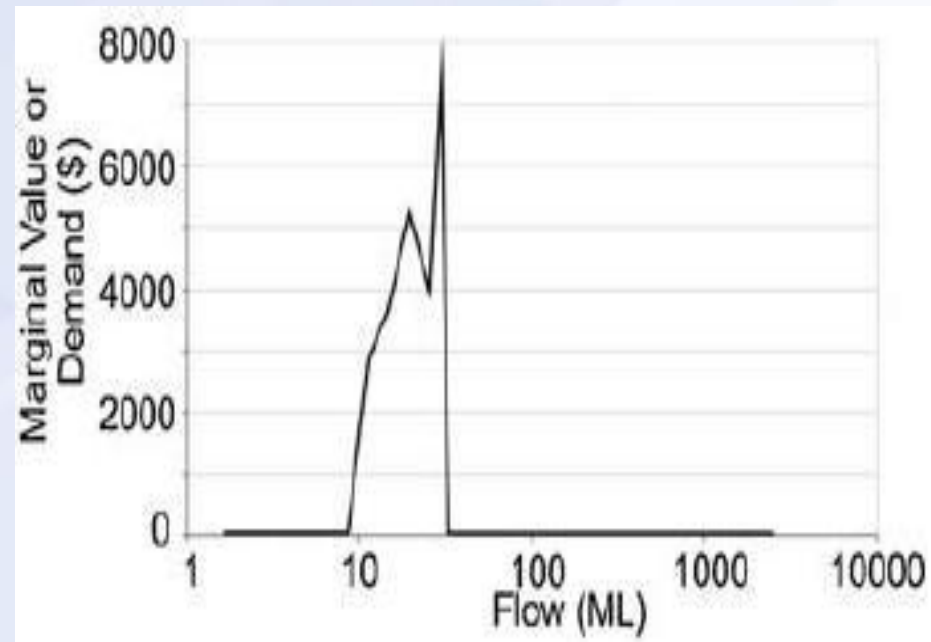


Minimum rather than maximum



Are these possibilities worth addressing?

- Empirical evidence on shapes of marginal benefit curves
- Alternatively, will it be efficient to water all ecosystems?



Goddard et al.

- Dynamic programming model with stochastic rainfall
- Allocating water between two ecosystems and storage
- Irreversibilities
- Sometimes optimal to only water one ecosystem
- Does not allow for not marginal solutions or corner solutions caused by convex benefit functions

Inframarginal economics

- Applies non-classical mathematical programming techniques to solve problems that might have corner solutions
- Used to look at specialisation in the context of international trade (Cheng et al. 2000)

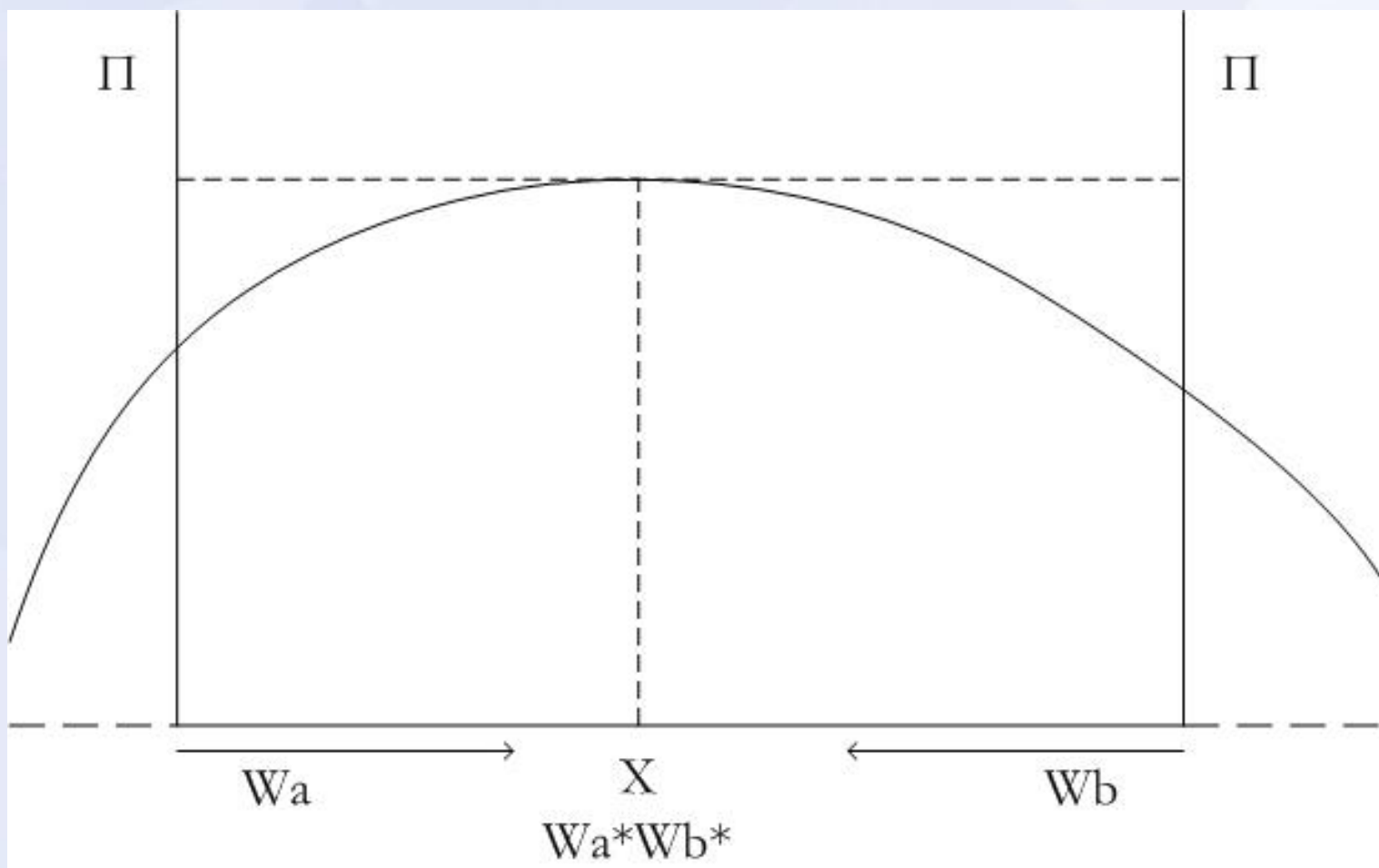
The water allocation model

- Single period allocation decision
- Allocate water between two ecosystems to maximise returns, subject to constraints
- Quadratic environmental production functions with interaction terms
- Output prices exogenous

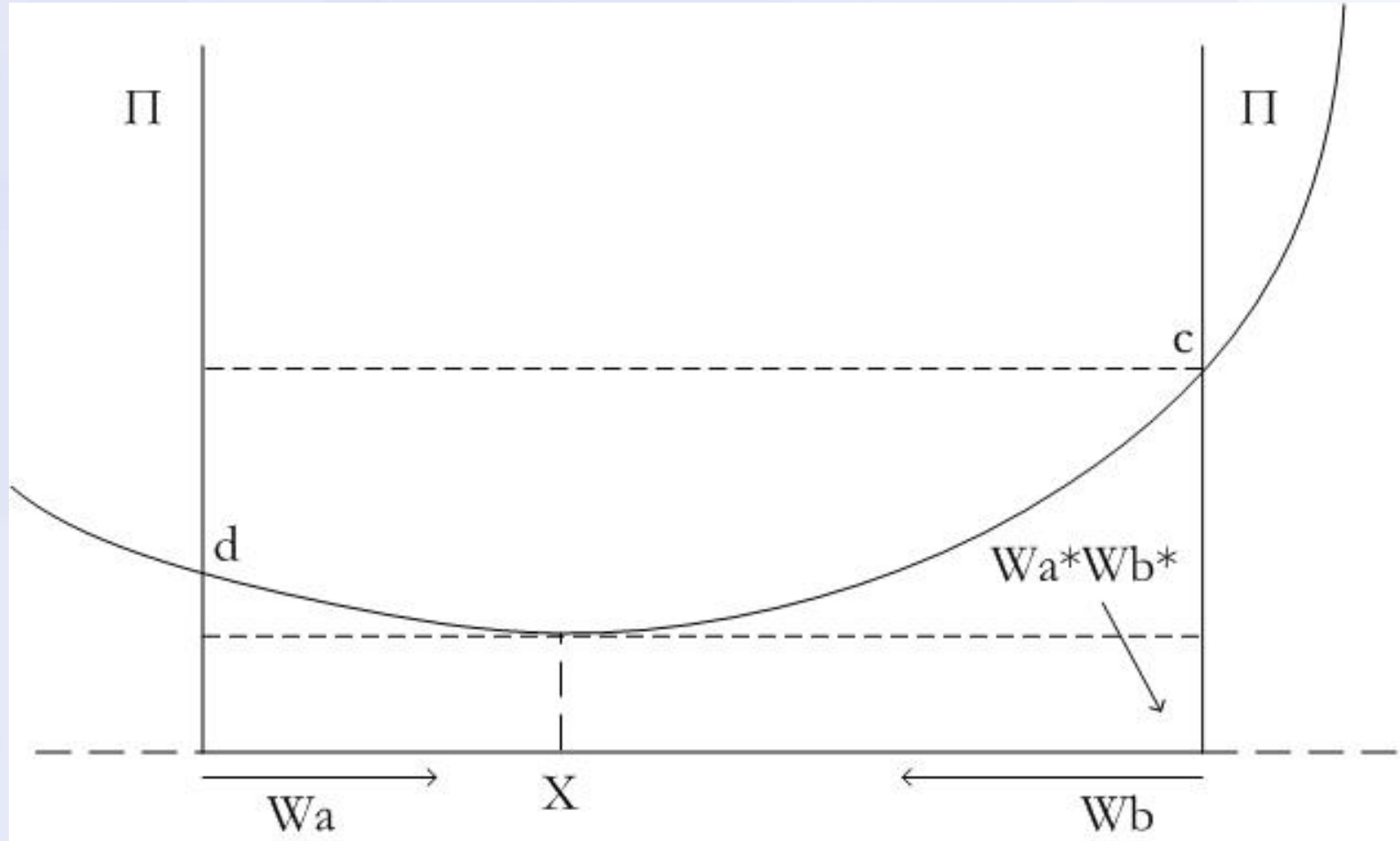
The water allocation model

- Three potential configurations:
 - water both ecosystems
 - water ecosystem a only
 - water ecosystem b only
- Find conditions (parameter subspace) under which these configurations apply
- Need to investigate:
 - interior stationary point
 - corners are local maxima or minima
 - number of stationary points
 - concave or convex

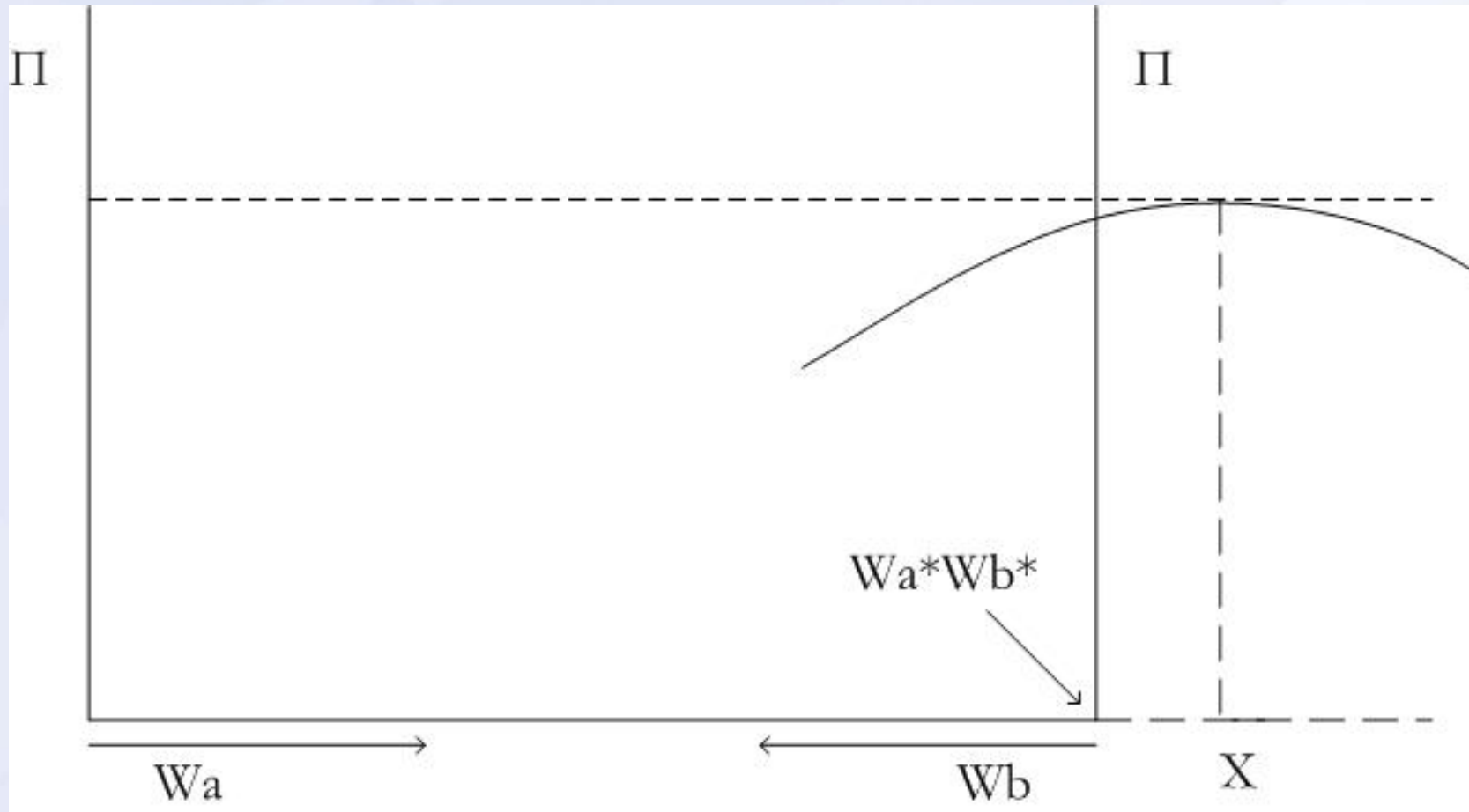
Concave interior stationary point



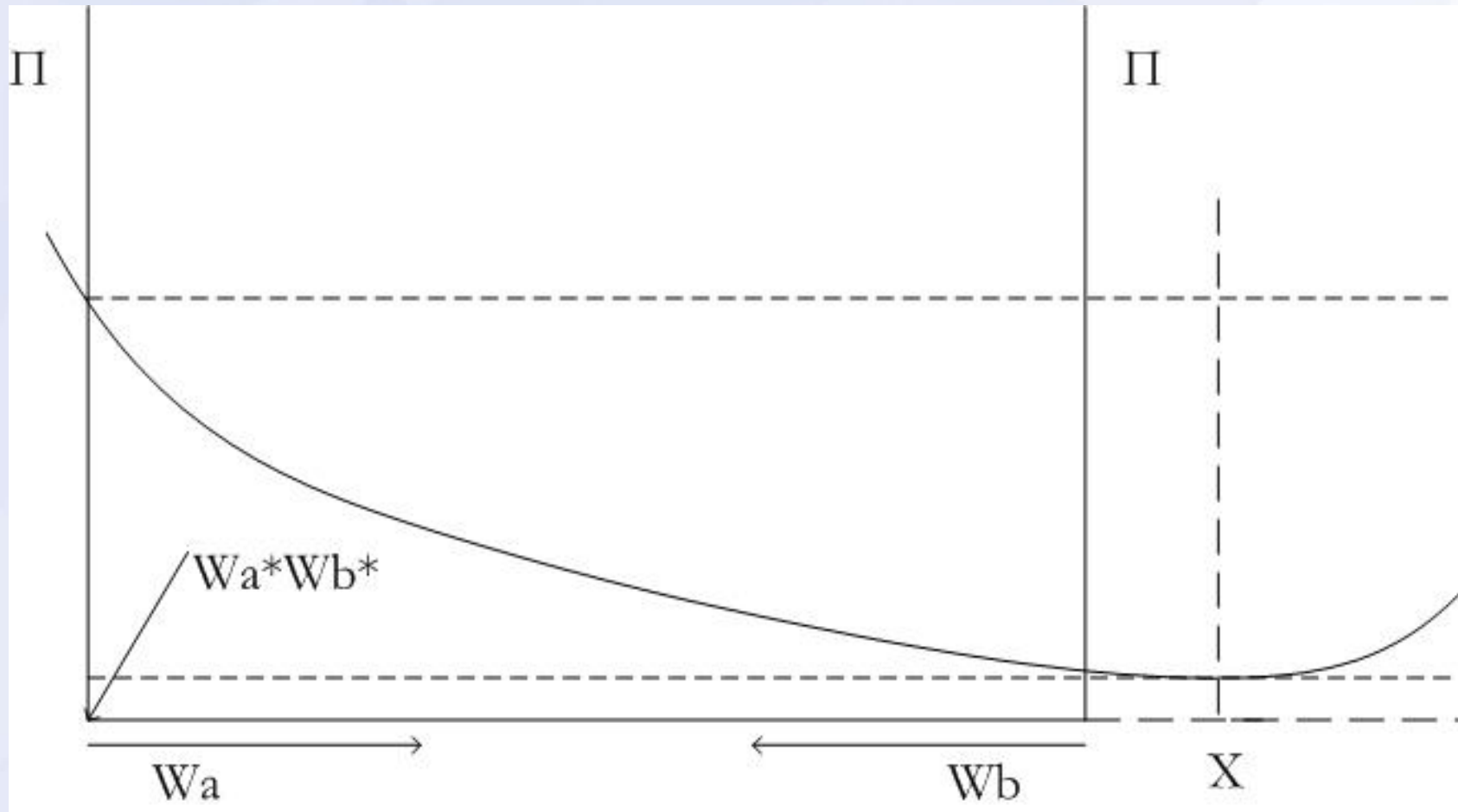
Convex interior stationary point



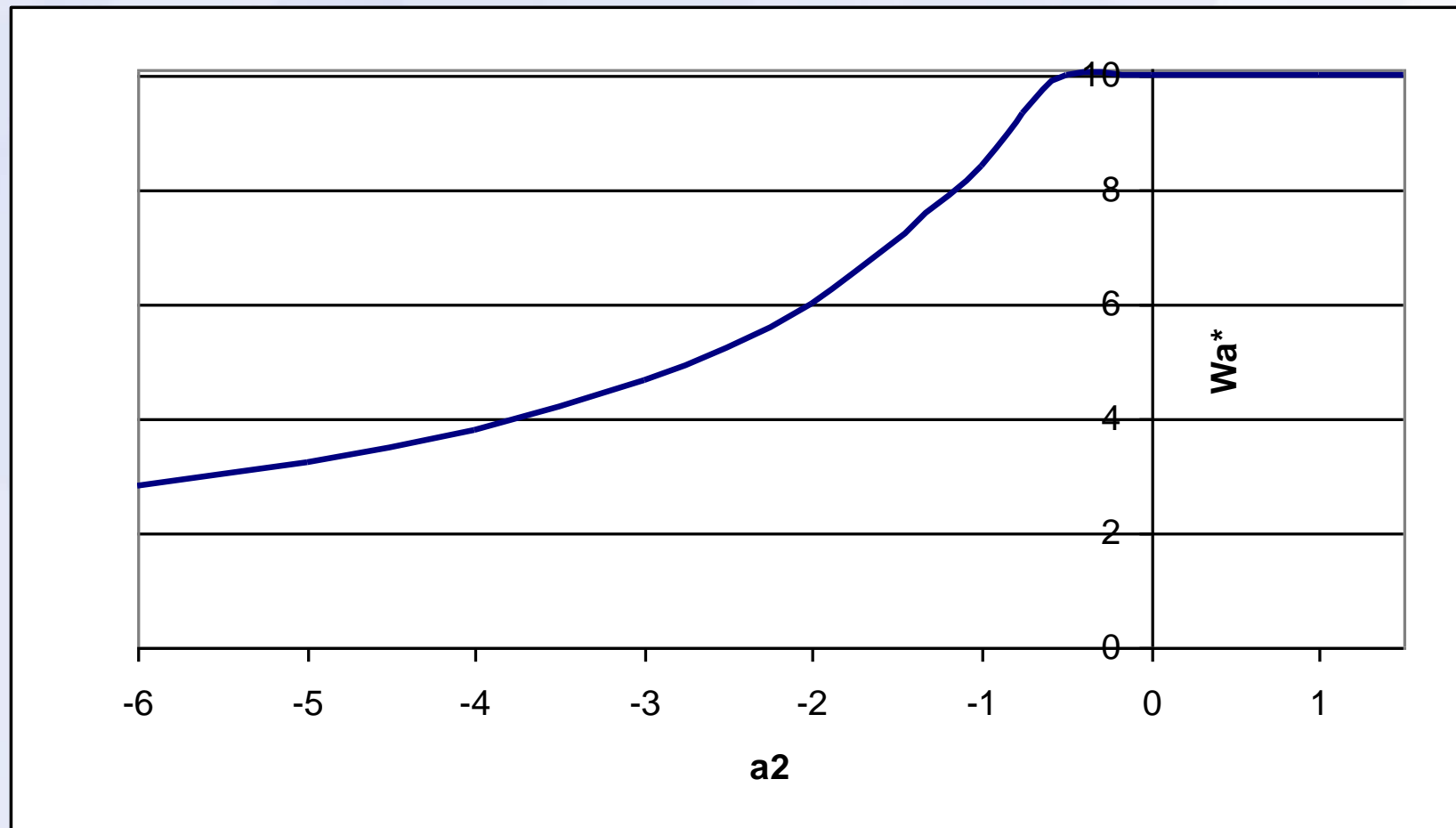
Corner solution (concave, no stationary point)



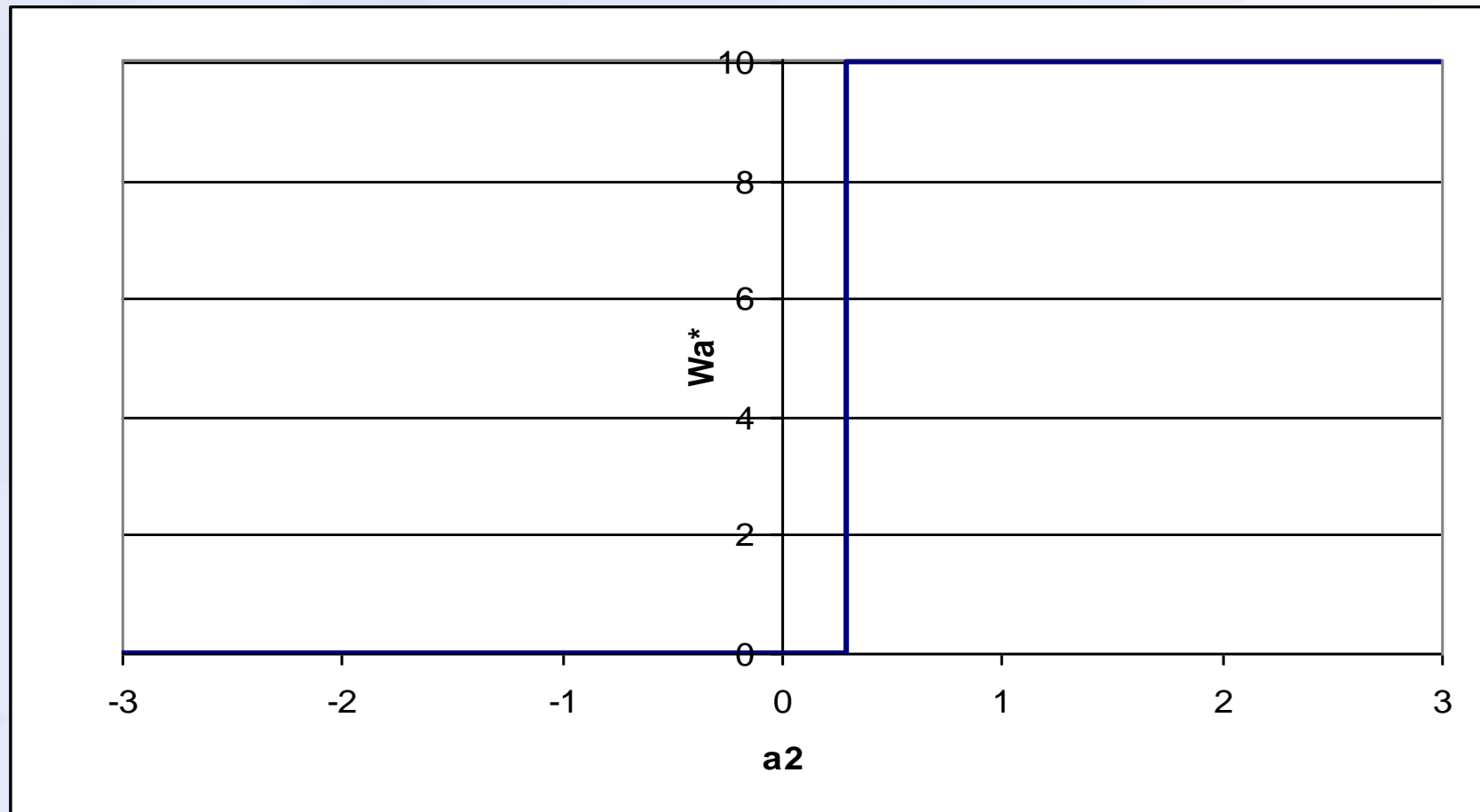
Corner solution (convex, no stationary point)



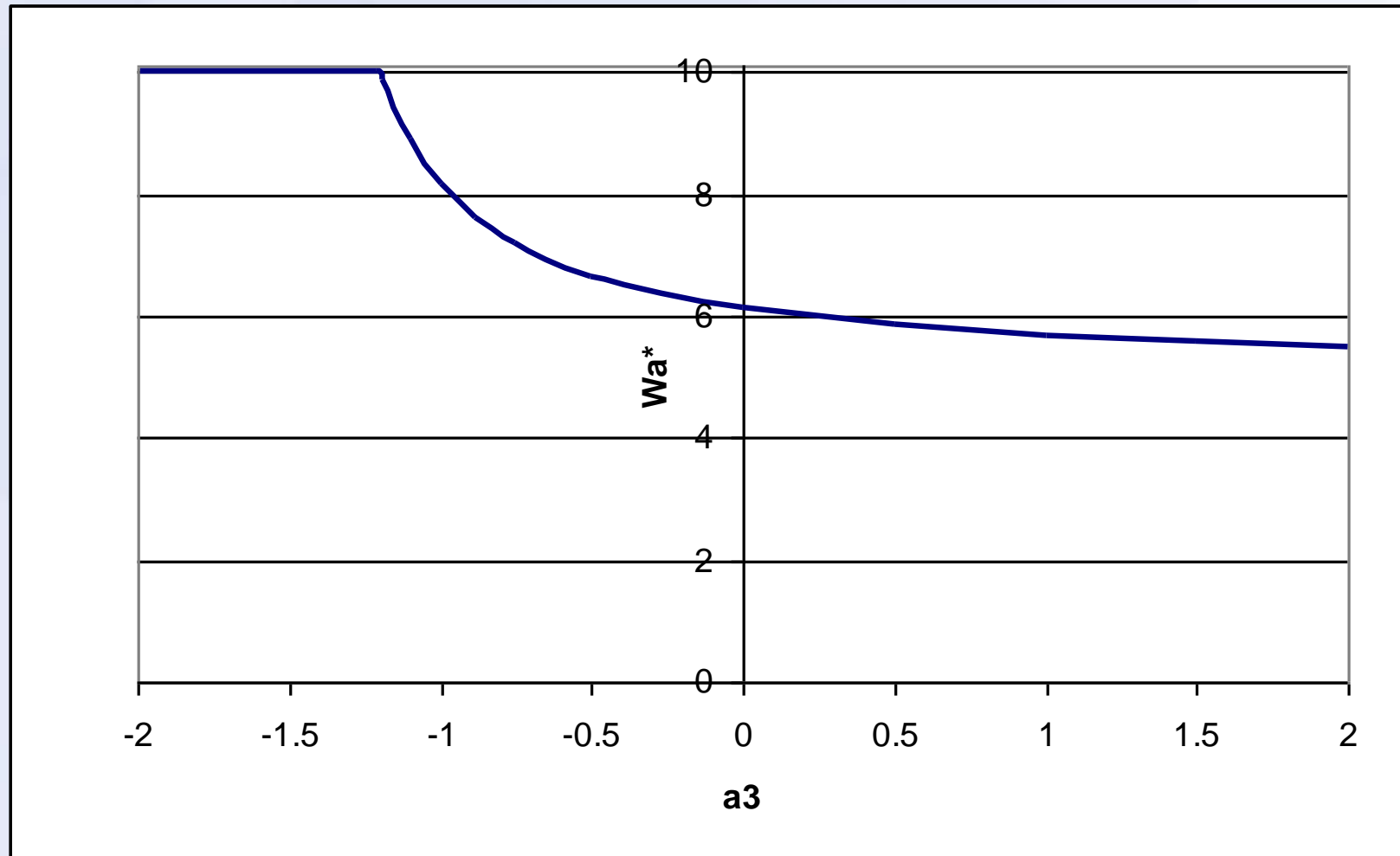
Model results, hypothetical data (quadratic term)



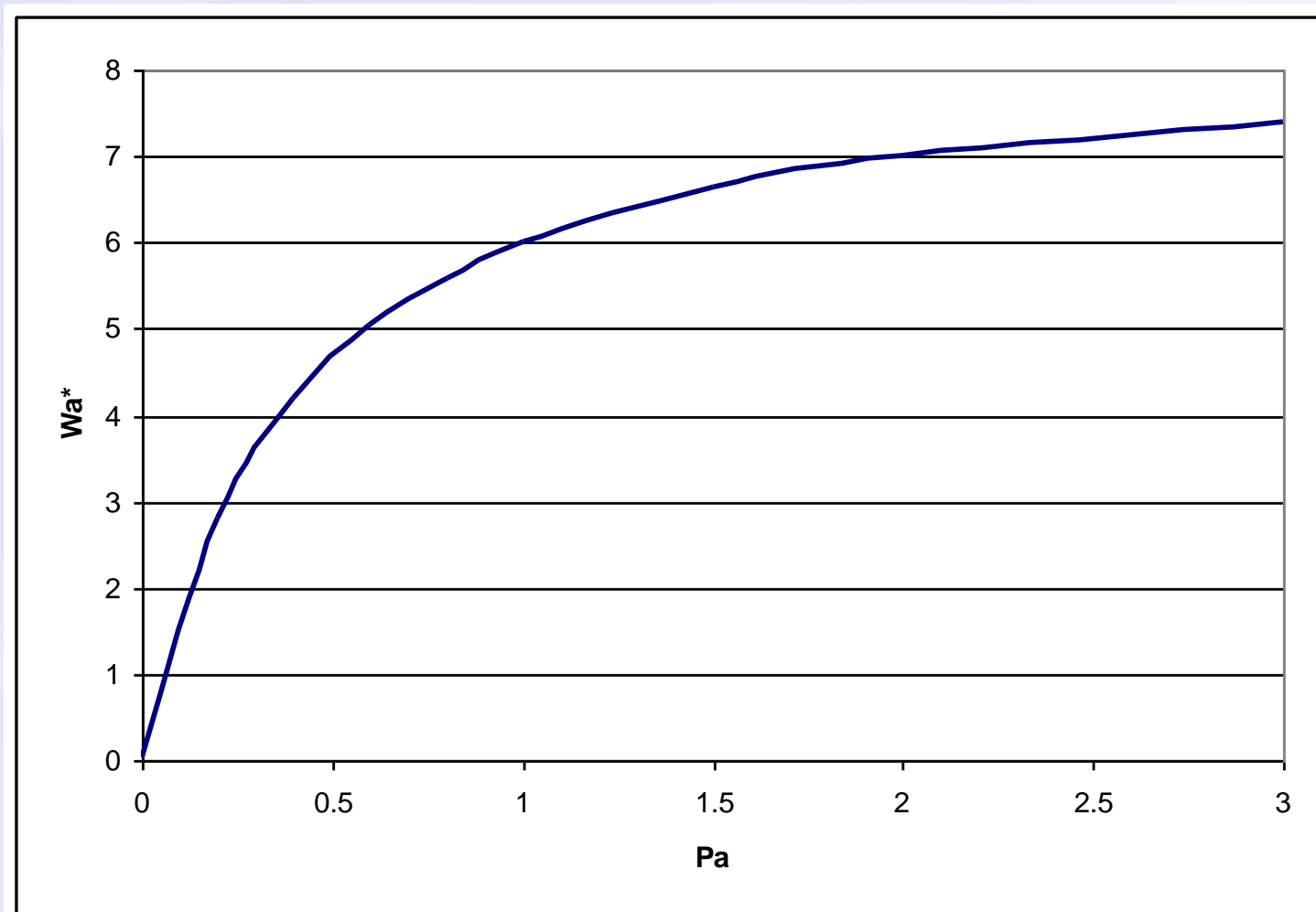
Model results, hypothetical data (quadratic term)



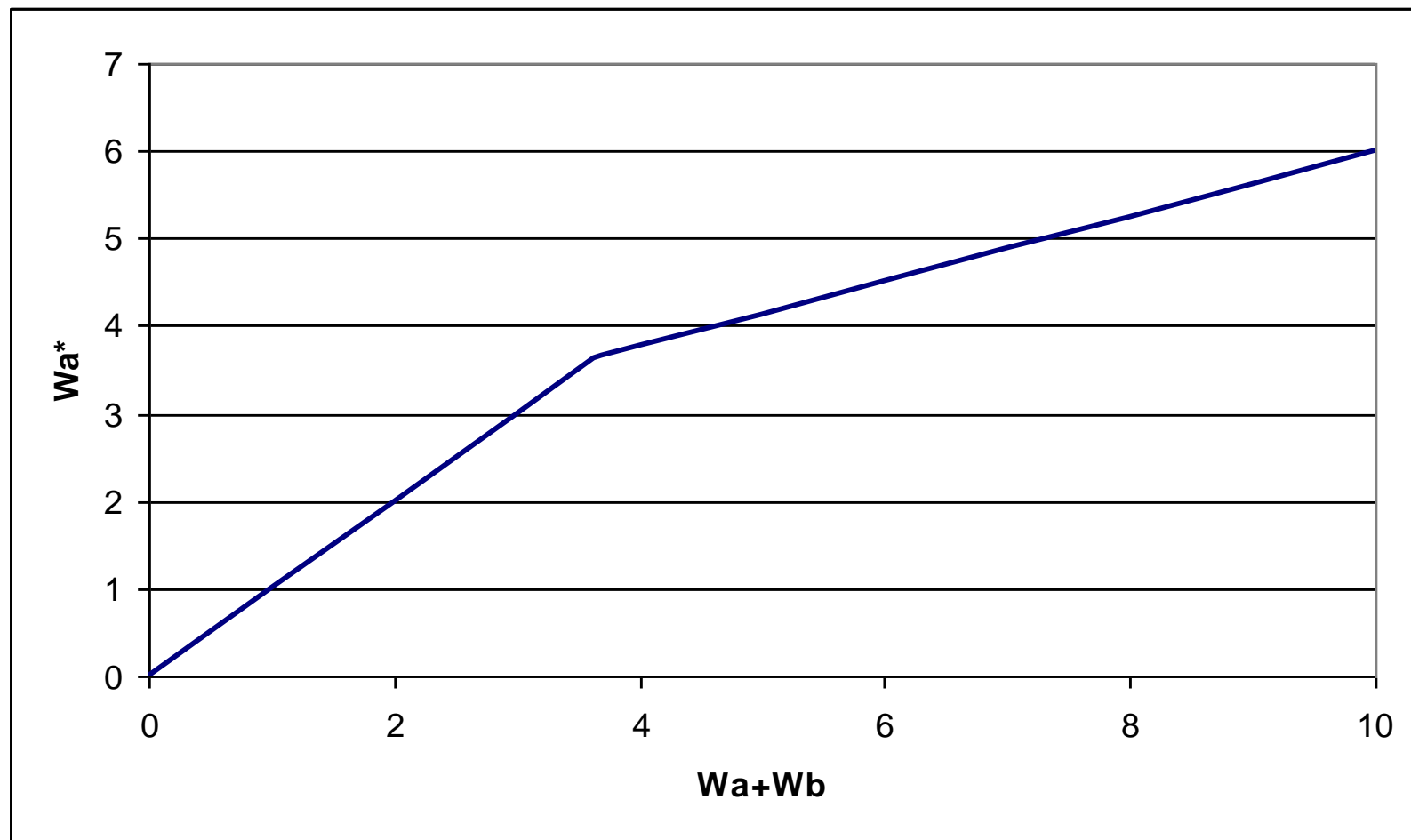
Model results, hypothetical data (interaction term)



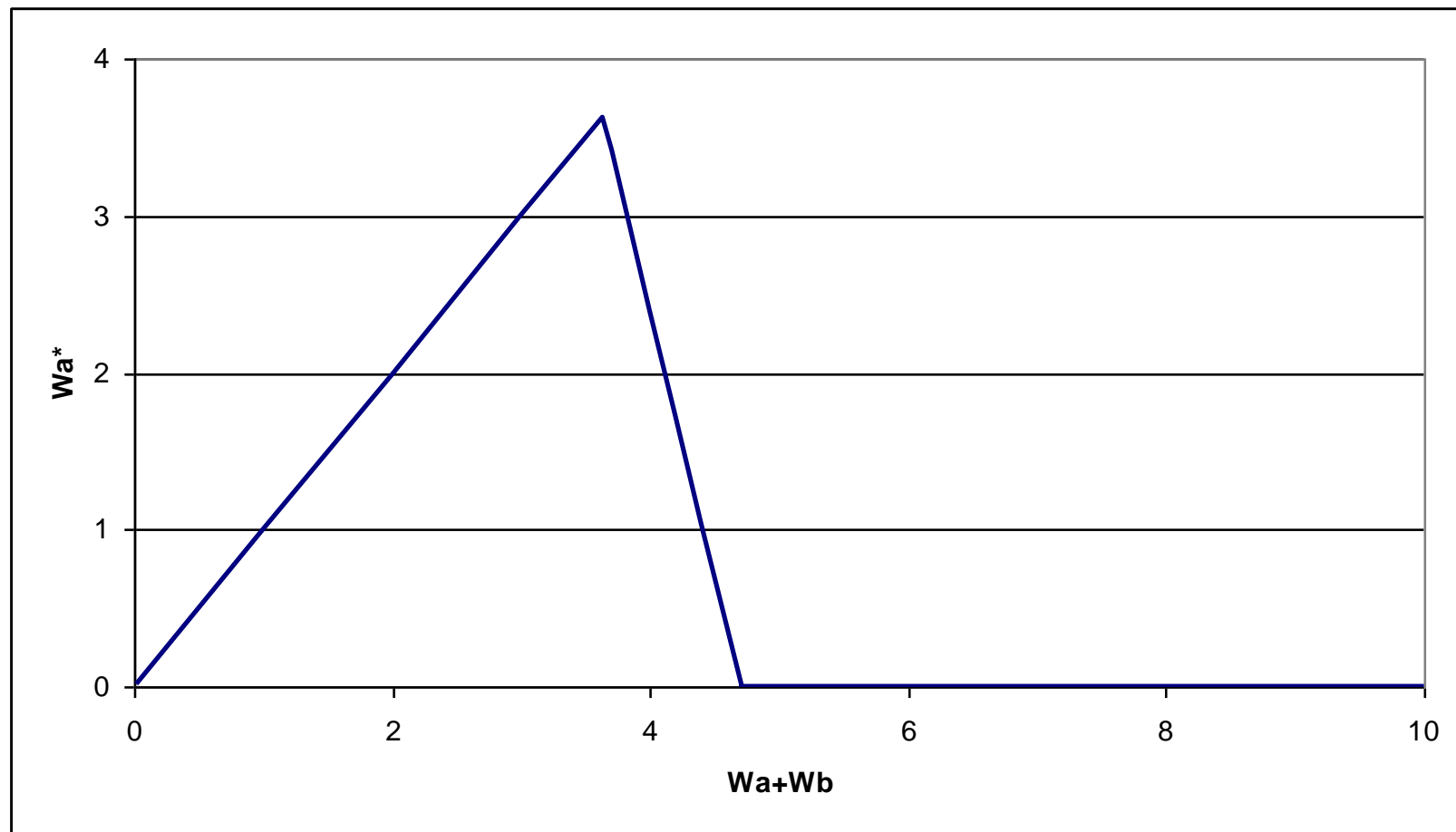
Model results, hypothetical data (price term)



Model results, hypothetical data (water availability term)



Model results, hypothetical data (water availability term)



Conclusions

- Corner solutions are possible even when both environmental benefit functions are concave
- In this case, more likely to get corner solutions: a) lower the interaction term and b) smaller the volume of water available
- Corner solutions assured when both environmental benefit functions are convex
- Don't necessarily expect smooth or continuous responses

Conclusions

- Theory likely to be widely applicable
- Areas for further research
 - Dynamics and uncertainty surrounding inflows and environmental responses
 - Ability to carryover water
 - More than two ecosystems
 - More realistic environmental production functions
 - Empirical data

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